

# Hoist-Block

AIN SHAMS UNIVERSITY  
FACULTY OF ENGINEERING

MACHINE CONSTRUCTION  
2ND YEAR MECHANICAL  
1979 - 1980

## EXERCISE (I)

### An Ordinary Single-Sheave Hoist-Block.

Guided by the given sketches of the hoist blocks, the 1.370 ton capacity standard hook and , the sheave rim ; it is required to make a complete constructional drawing for a 1.25 ton hoist block . The wire rope is selected to have the following specifications :

Nominal rope diameter = 11.2 mm.

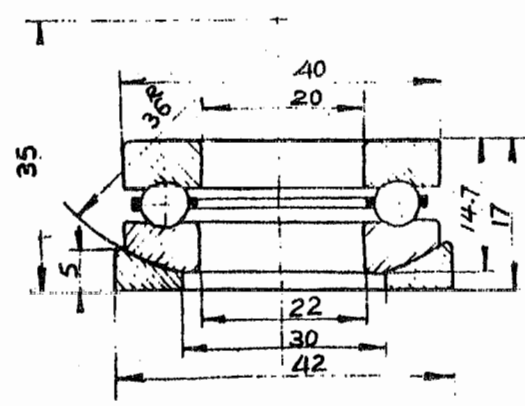
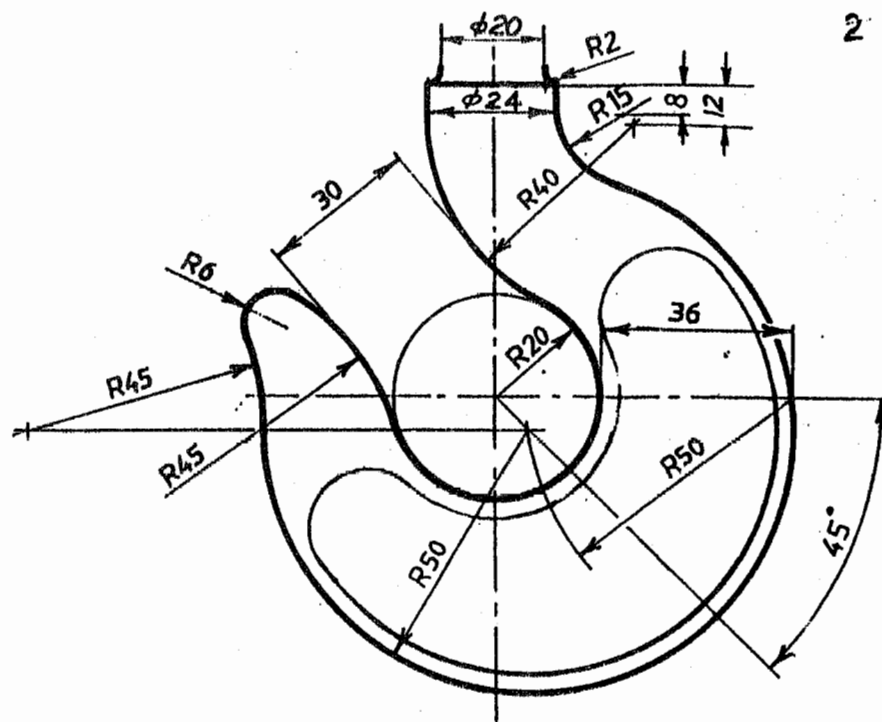
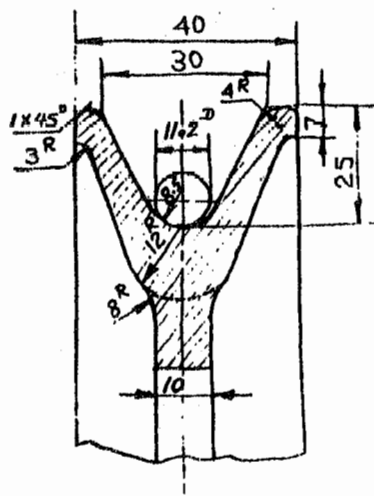
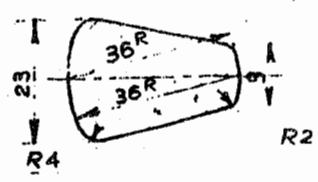
Wire diameter = 0.71 mm.

U.T. strength of wire material = 180 kg/mm<sup>2</sup>

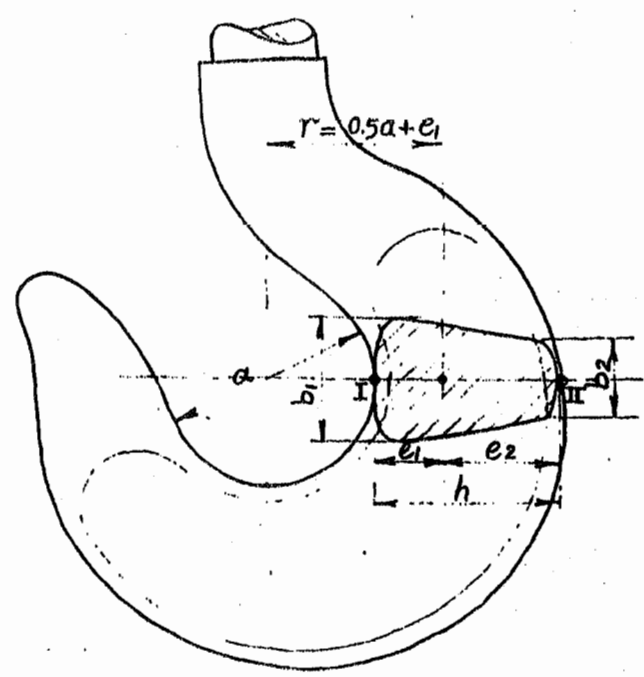
Cross laid type 6x19 = 114

The hoist is to be manually operated and a sheave diameter of 20 times the rope diameter is a minimum value .

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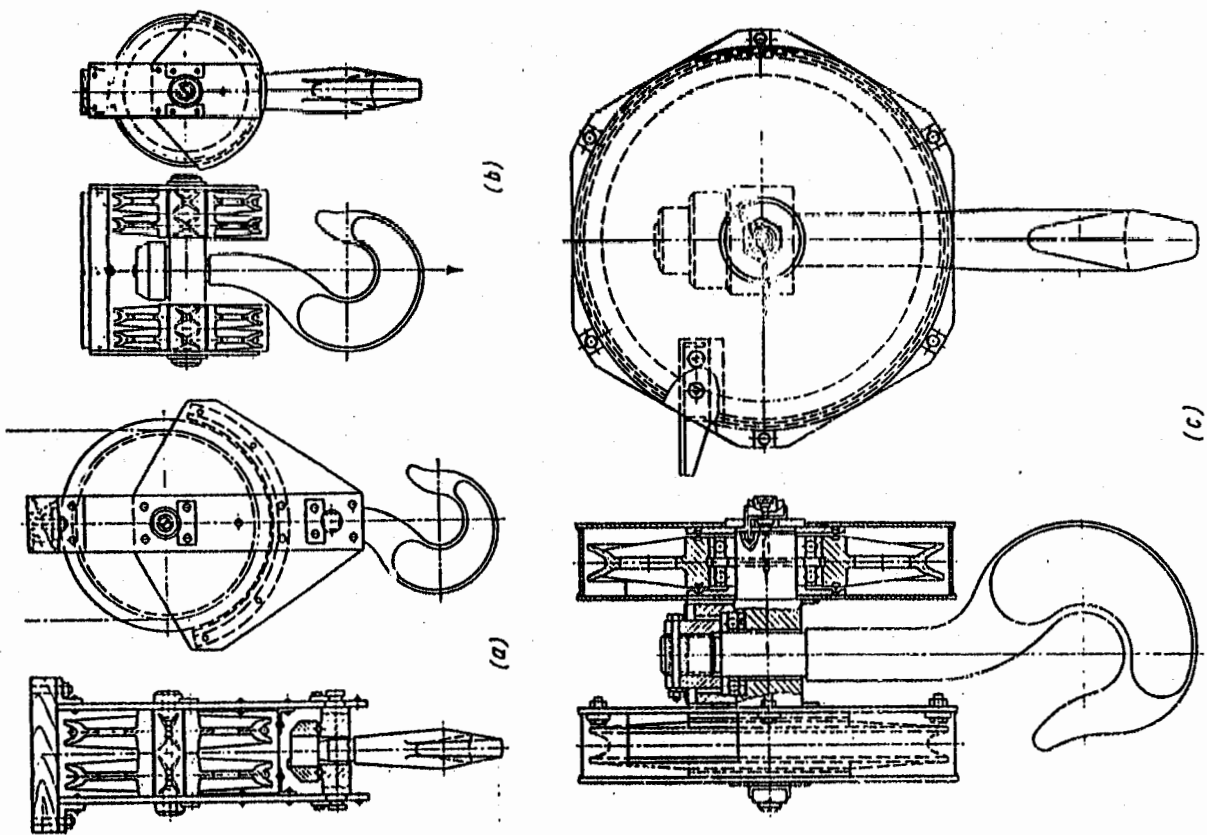
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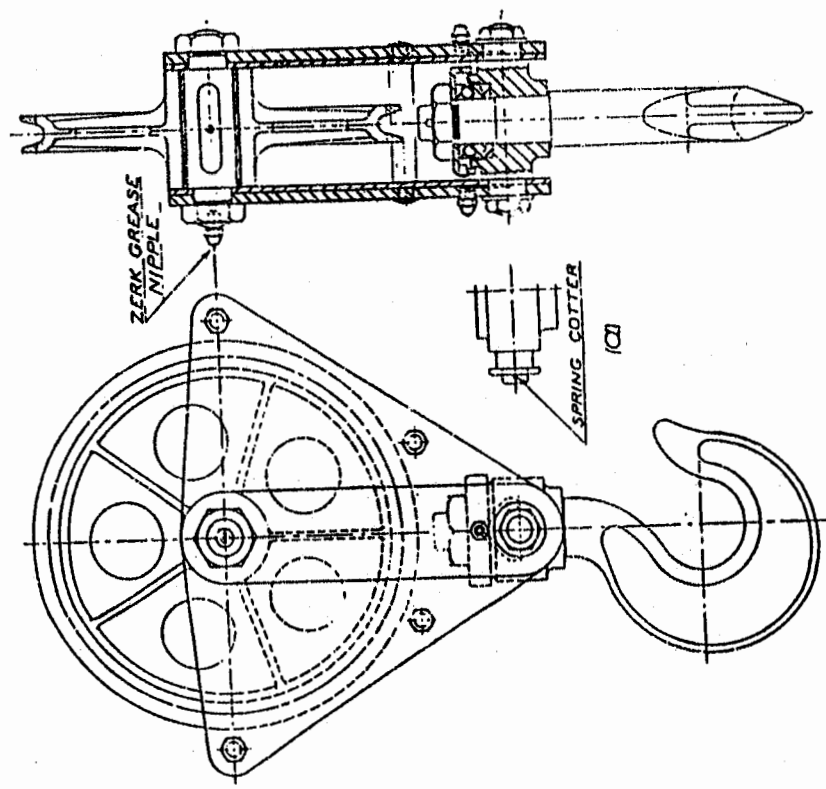
$$\sigma_I = \frac{Q}{A} \cdot \frac{1}{x} \cdot \frac{2e_1}{a} \leq \sigma_{all.}$$

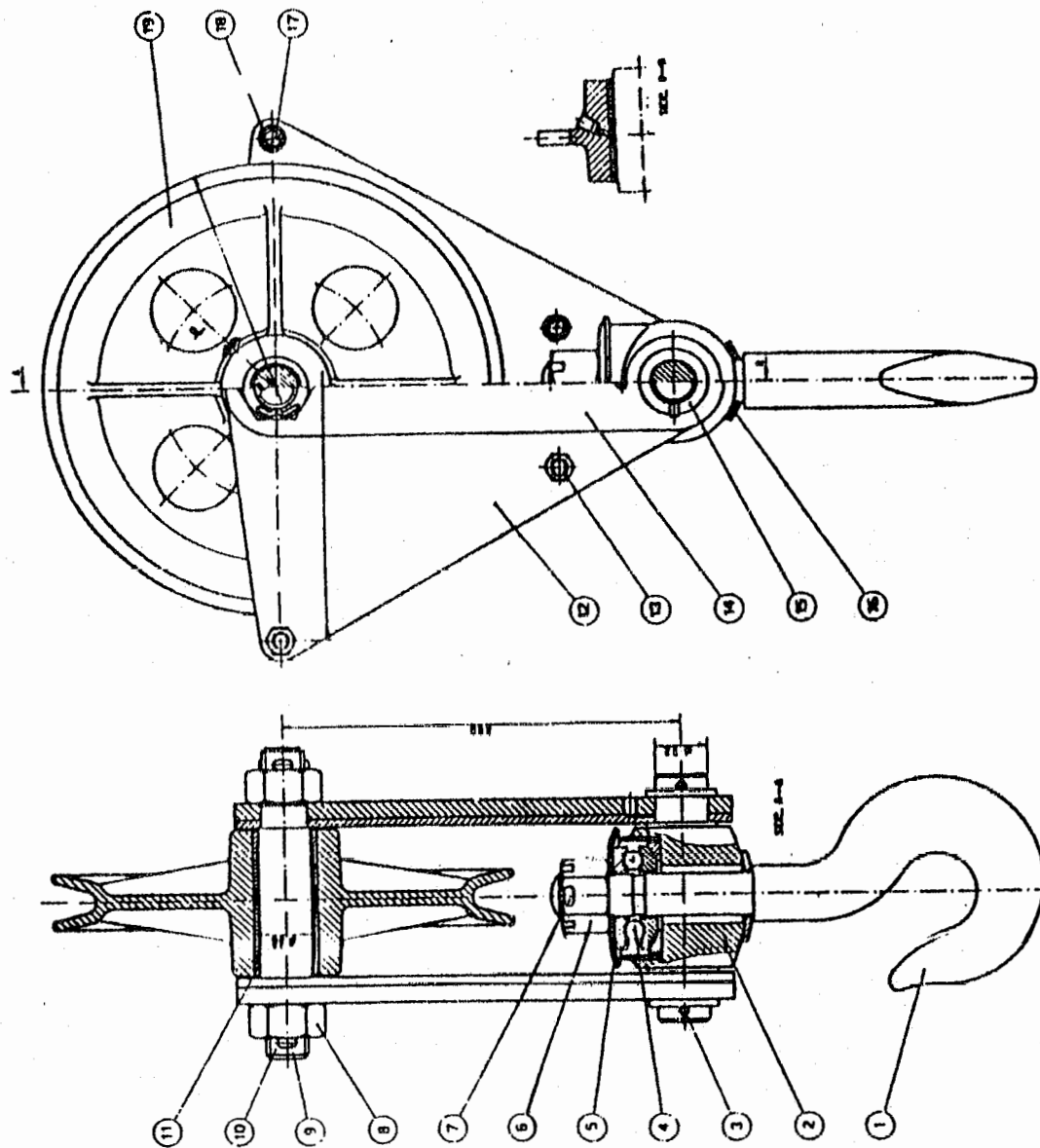
$$\sigma_{II} = -\frac{Q}{A} \cdot \frac{1}{x} \cdot \frac{2e_2}{a+2h} \leq \sigma_{all.}$$

$$x = -1 + \frac{2r}{(b_1 + b_2)h} \left[ \left\{ b_2 + \frac{b_1 - b_2}{h} (e_2 + r) \right\} \ln \frac{r + e_2}{r - e_1} - (b_1 - b_2) \right]$$



Hook casings





SINGLE-SHEAVE  
HOOK CASING

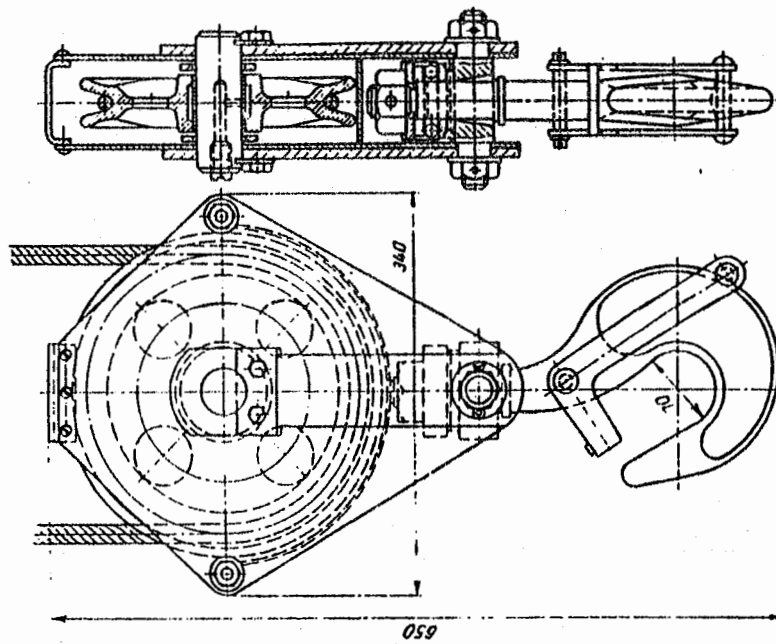


Fig. 77. Ordinary single-sheave hook casing

Single sheave hoist block:  
Guide-lines for calculations:

\* Lifting Capacity =  $1.25 t = 12.5 \text{ kN}$   
 Test load =  $1.25 * 12.5 = 15.33 \text{ kN}$

Calculations & checks are carried out for :

- a - Sheave axle
- b - Side strips
- c - Hook supporting block.

a - Sheave axle

From freehand sketch

Axle diam =  $d = 30 \text{ mm}$

Span (average) =  $60 \text{ mm}$

a-1) Bending Stresses:

$p = \frac{15330}{50} = 306.60 \text{ N/mm}^2$

$B.M._1 = \frac{p l^2}{8} = \frac{306.6 * 50^2}{8} = 95813 \text{ N.m.}$

$B.M._2 = 7665 * 5 = 38325 \text{ N.m.}$

Max B.M. =  $134138 \text{ N.m.}$

$\sigma_{\text{bend test}} = \frac{134138 * 32}{\pi (30)^3} = 50.6 \text{ N/mm}^2$

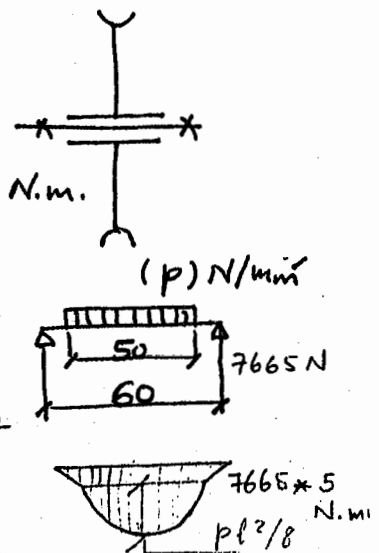
Min. yield stress  $\geq$  margin of safety

\*  $\sigma_{\text{bend test}}$

\* margin of safety =  $1.3 \rightarrow 1.8$

$\therefore \sigma_y \geq 1.8 * 50.6 \geq 91 \text{ N/mm}^2$

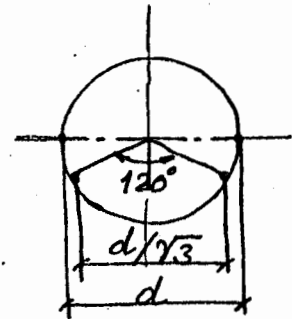
for: St. 37,  $\sigma_y = 200 \text{ N/mm}^2 \rightarrow$  suitable for L, C, I  
 St. 42,  $\sigma_y = 220 \text{ N/mm}^2 \rightarrow$  suitable for axles & rods



a-2) Check for bearing pressure;

For St/Br, allowable bearing pressure = 17 MPa

$$\begin{aligned}\text{Working bearing pressure} &= \frac{12500\sqrt{3}}{30 \times 50} \\ &= 14.1 \text{ N/mm}^2 < 17 \text{ MPa}\end{aligned}$$



a-3) Crushing in side plates;

$$\begin{aligned}\sigma_{cr.all} &= \sigma_{yt}/1.5 \\ \sigma_{cr.test} &= \frac{1}{2} * \frac{15330}{12 * 30} = 21.3 \text{ N/mm}^2\end{aligned}$$

The axle suitable material is St 42

Note:

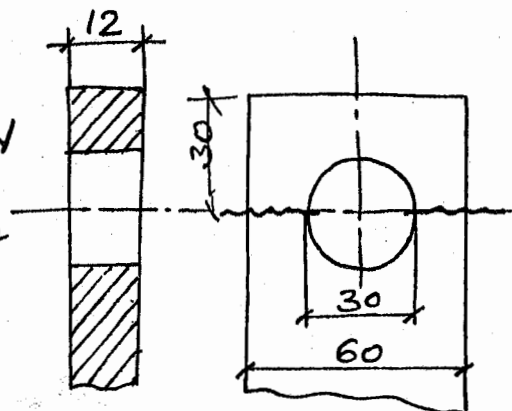
$$\sigma_b \text{ working} = 50.6/1.25 = 40.5 \text{ N/mm}^2$$

$$\text{i.e. Working Safety factor} = \frac{220}{40.5} = 5.43$$

b- Side plate

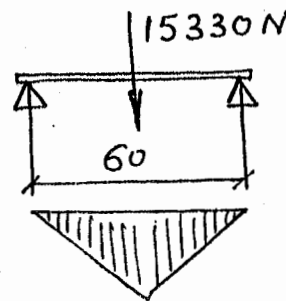
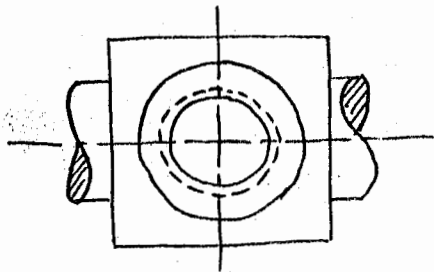
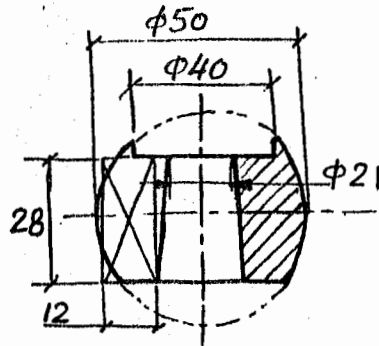
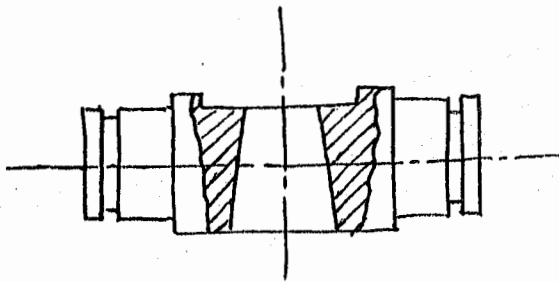
$$\text{Test load/side} = \frac{15330}{2} = 7664 \text{ N}$$

$$\sigma_t = \frac{7664}{(60-30)(12)} = 21.3 \text{ N/mm}^2$$



Suitable material is St. 37.

### C - Hook Supporting block:



$$\begin{aligned} \text{Bending moment} &= \frac{Pl}{4} \\ (\text{test case}) &= \frac{15330 \times 60}{4} = 230000 \text{ Nmm} \end{aligned}$$

$$Z_b = bh^2/6 = 12(28)^2/6 = 1568 \text{ mm}^3$$

$$\sigma_b = M/Z = \frac{230000}{1568} = 146.7 \text{ N/mm}^2$$

$$\begin{aligned} \text{Material yield stress } \sigma_y &\geq \sigma_b \times 1.8 \\ &\geq 264 \text{ N/mm}^2 \end{aligned}$$

Suitable materials:

$$\begin{aligned} \text{St. 60} , \text{ St. C15} , \text{ C22} \\ (\sigma_y = 300 \text{ N/mm}^2) (\sigma_y = 300 \text{ N/mm}^2) (\sigma_y = 300 \text{ N/mm}^2) \end{aligned}$$

